

## Take the guesswork out of green

- By John Zyskowski
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Successful green computing initiatives rely on a power audit that includes 3 basic steps

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### The measure of metrics

Managers can find dozens of useful metrics and data points to benchmark energy efficiency in their data centers, but there are three measures that experts say every audit should include.

- **Power usage effectiveness:** Supported by the Green Grid, an association of information technology professionals dedicated to energy efficiency, PUE is the first metric auditors typically mention when describing a data center's efficiency. It is defined as a center's total power use (not the whole building's power use) divided by IT equipment power use. The difference between those two numbers is the amount of power used by all the noncomputer elements in the data center, such as generators, lights and cooling equipment.

A PUE of 1 would indicate 100 percent efficiency. A higher PUE number indicates less efficiency. No comprehensive industry data is available to illustrate the full range and distribution of PUEs. The Green Grid cites some preliminary data, supported by findings from Lawrence Berkeley National Laboratory, showing that a PUE of 3.0 or greater is common. However, with proper design, a PUE of 2 or less is achievable.

- **Data center infrastructure efficiency.** DCIE, also promoted by the Green Grid, is the reciprocal of PUE. It is calculated by dividing 1 by the PUE. For example, a DCIE value of 33 percent is equivalent to a PUE of 3. It means that the computer equipment uses 33 percent of the total data-center power.

Some green industry experts prefer DCIE because, unlike PUE, its value increases as efficiency goes up. That feature makes DCIE easier to understand and communicate to others.

- **IT equipment power density.** This measure is represented by watts per square foot of computer equipment. It provides a quick and useful indication of data-center design configuration with implications for power supply, cooling requirements and productivity.

— John Zyskowski

### Why audit?

The four main benefits of benchmarking a data

center's energy use are:

- Establishing a baseline performance as a diagnostic tool.
- Identifying operational or maintenance issues with existing equipment.
- Planning future investments and improvements.
- Developing design standards for future facilities.

*Source: Lawrence Berkeley National Laboratory*

You would have to be living in a cave for the past year not to know that the computers and data centers at your agency are generating the big numbers on your power bill. One industry- sponsored study from last winter suggested the government could save \$1.3 billion in energy costs in five years by using new energy-efficient computers and improving data center operations.

But you will never know how much green products and practices might cut your agency's energy costs — or come up with a plan for achieving those savings — unless you know your current information technology-related power consumption.

To discover that information, experts recommend doing a power audit.

“No serious green computing project should begin without first doing a baseline audit to know where you are starting from,” said Karen Larkowski, founder and chief evangelist at the Green Computing Impact Organization. The group offers free energy audits and education programs supported by businesses that are members of the nonprofit group.

Agencies that want an energy audit can hire one of the many companies that provide those services, or they can perform it on their own using some of the free resources available.

For example, Lawrence Berkeley National Laboratory offers on its Web site step-by-step instructions for self-benchmarking a data center's energy consumption. William Tschudi, a program manager at Berkeley Labs' Environmental Energy Technologies Division, and his colleagues developed the guidance while they were collecting data that went into the Environmental Protection Agency's 2007 report to Congress on data center power usage.

Now the lab is working on a software-based self-benchmarking application named Data Center Pro, or DC Pro. A beta version will be available in May. The software will guide auditors through the benchmarking process, analyze the data they collect and identify areas that present the greatest savings opportunities, Tschudi said.

Before beginning to measure energy use, agency executives should set goals for the audit. Those goals will determine how thorough the audit must be.

Ask yourself a series of questions, said Yogesh Khanna, vice president and chief technology officer of IT infrastructure solutions for CSC's North American public- sector division. Is your goal to reduce the energy consumption of your IT equipment? Will you include the cooling gear? Or do you want to take a comprehensive audit that includes lighting, heating, ventilation and other systems that draw power?

Here are some of the basic steps to expect during an audit, which can take a few days or several weeks.

### **Step 1: Inventory the current environment**

This is the grunt work of the audit, but it is important for several reasons, Larkowski and other experts said.

One benefit of an audit is that it gives managers the ability to compare their data centers with others operating at varying degrees of energy efficiency. The audit lets them track their progress as they make changes. Knowing the amount of the monthly power bill at a data center tells you nothing about its energy efficiency. You also need to know how many and what kinds of equipment are consuming that energy.

An inventory can also quickly reveal problem areas that are top candidates for fixing, such as aging or forgotten equipment, ineffective cooling systems and underused computers.

“Often with distributed server farms, there are orphans or ghost servers that nobody knows are there,” said David Anderson, a green architect at IBM’s Systems and Technology Group. “You measure them and find out that they have low utilization or that they’re running at 100 percent, even though they don’t have any work on them.”

Performing an inventory provides another benefit: It reveals the places where placing power and other measurement devices during the audit will produce the most useful data.

The size of the inventory list will be dictated by the audit’s goals, but the list could be quite long. It would include IT equipment such as servers, appliances, and network and storage devices. It should contain all supporting data center equipment, such as power distribution units, uninterruptible power supplies, computer room air conditioners and heating and ventilation equipment.

In addition, the data center inventory must contain recent utility bills and floor plans, including total space and unused space, wiring diagrams and dimensions of raised floors and ceilings.

## **Step 2: Decide what to measure**

This step will require managers to make some judgment calls.

“There is no recipe for what exactly to measure,” said Kfir Godrich, chief technology officer at EYP Mission Critical Facilities, a data center design and consulting firm recently acquired by Hewlett-Packard.

For many data centers, it will be sufficient to measure flow at the output of the power distribution unit (PDU) that supplies the computer equipment, Godrich said. Managers of smaller data centers or those who want more detailed information, might measure power farther downstream, such as at individual server racks. Some auditors might also find it useful to measure and account for power loss at different points along the supply chain, such as at PDUs, uninterruptible power supplies or standby generators.

Newer devices often have built-in monitoring capabilities that can provide power use data. Otherwise, auditors can connect specialized measurement devices to the power cords of data center equipment. Some local power companies will loan such devices to customers.

Larkowski said he would advise organizations to hire an experienced, certified electrician to help set up and remove the monitoring equipment and ensure that it is producing accurate readings.

Because half or more of data center energy is typically consumed by cooling equipment, auditors often want to measure the power flowing to those systems. Managers performing more comprehensive audits might also deploy a variety of monitors to measure temperature, humidity and airflow, Larkowski said. Some local electric companies offer free evaluation services for lighting, heating, ventilating and air conditioning systems, she said.

Managers doing data center audits often do not include PCs, laptops and printers located outside the data center. Audits exclude them not because those devices are power misers. They are not. However, their energy use performance is relatively simple, and worthwhile savings can be achieved by simply adopting industry best practices, such as powering them down at night or while they are inactive, Anderson said.

### **Step 3: Compare the data**

The final step of the audit is to gather data from the inventory and monitoring stations and express it in useful metrics and data points. Managers can then compare those figures with those from other data centers and track their own improvement.

The audit report is more than a diagnosis of the current environment and its problems. It can also be a prescription for future actions and investments.

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